

Beagle 2 Mission Operations: Architecture and Approach

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The Beagle 2 project is the UK-led effort that placed a small lander on the surface of Mars in December 2003, as a component of the European Space Agency's Mars Express mission. The primary purpose of the project is to examine the surface of Mars, performing astrobiology and geology experiments. A unique project in numerous aspects, the Beagle 2 lander has presented specific spacecraft operations challenges. For example, the nature of the mission dictates that the ground segment will not communicate with the lander directly, but through the ESA Mars Express and NASA Odyssey orbiters and their respective ground segments.

This paper describes the ground segment architecture of the Beagle2 mission from an operations perspective. A summary of the mission is given to introduce some key concepts in the operations strategy, followed by a description of each component of the lander operations network and their interactions, which include novel implementations that solve complex operations issues. The similarities and differences in strategy and procedures between a typical Earth-orbiting spacecraft scenario and Beagle 2 are discussed. This highlights some specific areas of interest within the spacecraft operations community: multi-site planning and control; international cooperation in data relay services; the mixing of strong industrial and academic teams; the use of 'off-the-shelf' solutions; the role of virtual reality; approaches to operations planning, systems security and team management; the user interface and internet technology; infrastructure requirements and costs; and support of standards.

Finally, a complete planning and operations cycle is demonstrated, including both platform management and science-related functions, illustrating system interactions, operations tasks and constraints, and the solutions implemented that have enabled a successful mission. The scenario provided is taken from real Beagle 2 mission operations, chosen to include each technology and ground segment asset described earlier.